II. **Solution by P. S BERG, Apple Creek, Ohio.**

50 cents, cost of chicken+\$9.25, change given to purchaser of chicken =\$9.75, amount paid by poulterer. 50% of \$50=\$25, amount received by poulterer. \$25−\$9.75=\$15.25 gain. \$15.25÷\$.50×100=3050. Therefore the poulterer gained 3050%.

In the second condition the purchaser makes \$20, and the cost is 75 cents, therefore the gain per cent. is 10÷.75=1333⅓.

An excellent solution with a different result from either of the above was received from *FRANK HORNE*, a former student of Kidder Institute, Columbia, Missouri.

PROBLEMS.

38. **Proposed by J. A. CALDERHEAD, B. Sc., Superintendent of Schools, Limaville, Ohio.**

What must be the thickness of a 36-inch shell, in order that it may weigh 1 ton; supposing a 13-inch shell to weigh 200 pounds, when two inches thick?

39. **Proposed by P. C. CULLEN, Superintendent of Schools, Brady, Nebraska.**

A, B and C start from same point at same time. A north at rate of three miles per hour, B east at rate of four miles and C west at rate of five miles per hour. B at end of two hours starts at such an angle as to intersect A. How long after starting must C start north-west in order to meet A and B at common point.?

ALGEBRA.

Conducted by J. M. COLAW, Monterey, Va. All contributions to this department should be sent to him.

SOLUTIONS TO PROBLEMS.

27. **Proposed by A. H. BELL, Hillsboro, Illinois. (The problem from H. C. WILKES, Murrayville, West Virginia.)**

An oarsman in rowing a boat down stream 7 miles from A to B and then back requires 12 minutes longer time, than commencing from B, and rowing up and back; the rate of speed for the 1st half of the time is 5 miles per hour, and for the 2nd half of the time is 4½ miles per hour. Required the current.

I. **Solution by H. C. WILKES, Murrayville, West Virginia.**

Let $5+x$=rate down stream; and $5-x$=rate up.

$7+7\left(\dfrac{5+x}{5-x}\right)=\dfrac{70}{5-x}$ =length of continuous trip down=in time to trip down and up.

$7+7\left(\dfrac{4\frac{1}{2}-x}{4\frac{1}{2}+x}\right)=\dfrac{63}{4\frac{1}{2}+x}$ =length of continuous trip up=in time to trip up and down.

The change of rate in both trips will occur while going up stream and will be in the ratio $5-x:4\frac{1}{2}-x$.

$$\therefore\quad \left(\frac{70}{5-x}\right)\left(\frac{5-x}{9\frac{1}{2}-2x}\right)=\text{distance 1st half of down trip.}$$

$$\left(\frac{63}{4\frac{1}{2}+x}\right)\left(\frac{5-x}{9\frac{1}{2}-2x}\right)=\text{distance 1st half of up trip.}$$

As the difference of time for whole trips is 12 minutes, the difference for $\frac{1}{2}$ time will be 6 minutes, or $\frac{1}{10}$ hour.

Then $\dfrac{70}{(5+x)(9\frac{1}{2}-2x)}-\dfrac{63}{(4\frac{1}{2}+x)(9\frac{1}{2}-2x)}=\frac{1}{10}$, weich resolves into the equation $x^3+38x^2+99x-855=0$, whence $x=3$.

II. **Solution by A. H. BELL, Hillsboro, Illinois.**

Let x=current, rowing down $5+x=a$, $4\frac{1}{2}+x=c$, half time$=\dfrac{y}{2}=z$.

1st trip rowing up $5-x=b$, $4\frac{1}{2}-x=d$, half time$=\dfrac{y+\frac{1}{5}}{2}=s$.

Then $\dfrac{7}{a}$ = time A to B, $s-\dfrac{7}{a}=\dfrac{as-7}{a}$ = time left of the 1st half from B to C, and giving the distance $\dfrac{abs-7b}{a}$; $7-\dfrac{abs-7b}{a}=\dfrac{7(a+b)-abs}{a}$ = distance, C to A, and the time $\dfrac{7(a+b)-abs}{ad}=s=\dfrac{y+\frac{1}{5}}{2}$, giving $y=\dfrac{70(a+b)-a(b+d)}{5a(b+d)}$.

2nd trip--the 1st half of time from B to D gives the distance bz, distance D to $A=7-bz$, and time $=\dfrac{7-bz}{d}$, giving the time from A to $B=z$ $-\dfrac{7-bz}{d}=\dfrac{z(b+d)-7}{d}$.

The distance equals $\dfrac{cz(b+d)-7c}{d}=7$ miles, $z=\dfrac{7(c+d)}{c(b+d)}=\dfrac{y}{2}$, $y=\dfrac{14(c+d)}{c(b+d)}$. Equating the values of y, $c[70(a+b)-a(b+d)]=70a(c+d)$. Substituting values, $8x^3+38x^2+99x-855=0$, giving $x=3$, with the other values imaginary.

III. **Solution by B. F. BURLESON, Oneida Castle, New York, and D. G. DURRANCE, Jr., Camden, New York.**

Let x=rate of current; y=distance from B (returning) where the rate of rowing is changed; $2T$=time of rowing from A to B and return; $2t$ = time of rowing from B to A and return; z=dist. from A (going up) where the rate of rowing is changed.

Put $a=7$ miles, $b=5$ miles, and $c=4\frac{1}{2}$ miles. Also put $2d=\frac{1}{2}$ hour, difference in time in making the journeys.

Then, $\dfrac{a}{b+x}+\dfrac{y}{b-x}=T\ldots.(1)$; $\dfrac{a-y}{c-x}=T\ldots.(2)$; $\dfrac{a-z}{b-x}=t\ldots.(3)$;

$\dfrac{z}{c-x}+\dfrac{a}{c+x}=t\ldots.(4)$; and $T=d+t\ldots.(5)$.

From (2), $y=Tx-Tc+a\ldots.(6)$. From (3), $z=tx-tb+a\ldots.(7)$.

Substituteing value of y in (1), $\dfrac{a}{b+x}+\dfrac{Tx-Tc+a}{b-x}=T\ldots.(8)$.

From (5) and (6), $\dfrac{a}{b+x}+\dfrac{dx+tx-cd-ct+a}{b-x}=d+t\ldots.(9)$.

$$\text{Whence, } t=\frac{b^2d-2dx^2-2ab-bdx+bcd+cdx}{2x^2-b^2+bx-bc-cx}.$$

The value of z in (4), gives, $\dfrac{tx-tb+a}{c-x}+\dfrac{a}{c+x}=t\ldots.(10)$,

whence $t=\dfrac{2ac}{c^2-2x^2-cx+bx+bc}$. Equating these two values of t, after restoring numerical values, we have $\dfrac{252}{171-8^2+2x}=\dfrac{4x^2+x+1305}{950-10x-40x^2}$, from which $32x^4-326x^2-5301x=-16245\ldots.(11)$.

Factoring (11), $(x^2-7\frac{3}{4}x+14\frac{1}{4})(32x^2+248x+1140)=0$.

From first factor, $x=3$ or $4\frac{3}{4}$, and from 2nd $x=-8.25062$ or -7.24938. But of these values only $x=3$ is applicable. By substituting, $2T=5$ hours, $2t=4.8$, $y=3\frac{1}{4}$ miles, and $z=2\frac{1}{4}$ miles.

Also solved by *F. P. MATZ* and *G. B. M. ZERR*.

28. Proposed by H. W. DRAUGHON, Clinton, Louisiana.

The working capacity of a horse is constant between the ages of a and b years, and decreases at a uniformly accelerated rate from the age of b years to that of c years, becoming 0 at the latter age. If the value of the horse at the age of a years is d, give a formula for finding his value at any subsequent time.

Solution by the PROPOSER.

Let m represent the value of a year's work between the ages of a and b years; then, the value of the total amount of work done between those ages is, $(b-a)m\ldots.(1)$.

Let y be the value of the work which the horse could do in one year at the age of $c-1$ years, and let x be any variable time reckoned from the age of c years backward. Then from formulas for uniform acceleration, we have,